Pennsylvania, though numerous observations had been made on the direction of the striæ and the location of the moraines, in the northern part of the States, nothing had been attempted towards gathering the results into a consistent whole, or tracing the limits of the glaciation. In that year he succeeded in tracing a great terminal moraine from New Jersey to the Ohio frontier, and showing that beyond this line glaciation was absent, while within it the direction of the motion could be traced as well by the striæ as by the derivation of the boulders. Of the truth of these views he succeed in convincing almost all the American geologists who had studied the question. Fired by his success in interpreting the glacial phenomena of his native country, and believing that the same key might be found to unlock the mysteries of European glaciation, he practically threw up his position in Philadelphia, and devoted himself to the study of these phenomena in Great Britain. Devoting his summers from 1885 to the work, he visited—accompanied by his wife, whose active assistance he constantly enjoyed—almost every locality in Great Britain and Ireland where striæ had been recorded or moraines were likely to occur. To reduce the whole of the previous observations to order was a task he had not yet succeeded in completing, but which he boldly undertook, and to continue which he had once more landed in England. Important results were, however, already obtained, and at the British Association last year he gave English geologists the firstfruits, by presenting them with a map of England in which he had traced a great terminal moraine, as in America, on the north of which the striæ and the dispersion of the boulders indicated a continuous ice-sheet, while to the south the various glacial deposits were accounted for by extra-morainic lakes. He boldly advocated the view of the ice mounting up to the heights of 1100 feet in Moel Tryfaen and elsewhere, where the ice-sheet had crossed the sea, declaring that anyone who was acquainted, as he was, with the far greater results of ice-motion in Pennsylvania would have no difficulty in accepting this, and pointing out that these localities were everywhere on the line of the great terminal moraine. So startling a generalization could scarcely be accepted all at once, and there were many things to account for before the history even of this greatest ice-sheet could be considered complete. Had Prof. Lewis been spared to us, he was prepared to devote himself to the completion of this work. He has left a large mass of notes and drawings bearing on it, which must now wait for some Elisha capable of taking up his mantle. Every glacialist is no doubt more or less satisfied with the account he can give of the glacial history of his own district; but to the general geologist the whole has hitherto presented a chaos of conflicting histories, fit only to bewilder him. In the clear account given by Prof. Carvill Lewis of one great portion of that history, light seemed at last to dawn, and the hope was raised that glacial chaos would cease. This hope now seems quenched for a time.

Prof. Lewis was born in Philadelphia, November 16, 1853, and took his B.A. degree in 1873 in the University of Pennsylvania. From 1879 to 1884 he was a volunteer member of the Geological Survey of the State. In 1880 he was elected Professor of Mineralogy in the Academy of Natural Sciences, Philadelphia, and in 1883 Professor of Geology in Haverford College. His work was by no means confined to his glacial studies, the most important of his minor works being the discovery of the matrix of the diamond in an ultra-basic volcanic rock in contact with a carbonaceous tuff. The prediction that, if such was the origin of diamonds, they might be found in meteorites, had just been fulfilled in Russia; and he had lately visited a locality in Carolina, where the same conditions obtain, but had not proceeded further when he was stopped by death. During the last three years he spent his winters in Heidelberg, studying microscopic petrography with Prof. Rosenbusch.

Those who knew him personally, were charmed with the beautiful frankness of his nature, his love of truth, his invariable possession of a reason for what he said, and his total lack of pride or assumption of authority. They saw in him a type of what a genuine student of Nature should be, tempered and refined by general culture. Few who knew him at all but must feel they have lost a friend, and an example.

He married in 1882, and leaves a wife and one daughter.

*SONNET**

TO A HIGH SOPRANO

Accompanying herself on the Piano.

THE larks who sing at Heaven's high gate despair
To match thy notes so piercing-sweet and true
That, pure as in night's hour fresh-fallen dew,
Vouch thou art good, e'en as thou art most fair.
Why seek with gems to deck thy radiant hair,
Thy flashing, rushing, fingers to indue
With rubies' blaze or Opal's orient hue—
Thou canst in nobler wise thy worth declare.
Oft shall the rapt enthusiast in his cell
Intent on Nature's all-pervading clue
Pause, to bid Memory with her magic spell
Restore that heavenly, loved, lithe form to view
And in fond fancy hear thy voice anew
Till life to gladness breathes its last farewell.

New College, Oxford, July 20. J. J. S.

NOTES.

THE annual meeting of the British Medical Association was opened at Glasgow on Tuesday, the 7th inst. Prof. Gairdner, the President, delivered an address on "The Physician as Naturalist." Speaking of the methods of education necessary for the training of a physician, Prof. Gairdner urged that medical students do not at present receive adequate instruction in physics. "When we consider," he said, "how completely modern science has demonstrated the subordination of living bodies and physiological processes, not to a wholly detached set of laws termed vital, but to all the most elementary laws of matter; and, further, the correlation of all the physical forces throughout the universe, so that the living body and its environment act and react on each other throughout infinite space and time, it will be readily admitted, I think, that some kind of systematized instruction in physics, and not a mere elementary examination in mechanics, should be an essential part of an education with a view to the medical profession. And when we further consider that most of the great advances in medical diagnosis in the present day, through the stethoscope, microscope, laryngoscope, ophthalmoscope, sphygmograph, electricity as applied to muscle and nerve, &c., involve applications of pure physics which are neither remote from practice nor yet very easily mastered by the beginner; and that, in the case of electricity and other physical reagents, even heat and cold, &c., we are every day extending the domain of these sciences in therapeutics, and still more perhaps in preventive medicine and sanitary science, their claim for an extended recognition in teaching seems to be enormously enhanced. I am persuaded that in a very few years the physical laboratory will become an absolutely essential preliminary step in the education of the physician of the future, and that those who have not undergone this training will be hopelessly distanced in the race."

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* In the next number of NATURE will appear the Original of this sonnet addressed
To a Young Lady with a Contralto Voice.

The Organizing Committees of Sections A and G of the British Association have arranged a joint discussion on lightning conductors, to be held at the Bath meeting in September. Mr. W. H. Preece, F.R.S., will open the discussion, and Prof. Oliver J. Lodge, F.R.S., willl defend the position he laid down this year before the Society of Arts.

Agreeably to a resolution of the International Congress of Hydrology and Climatology held at Biarritz, in October 1886, the second triennial session of the Congress will be held in Paris next year, at the beginning of October, in connection with the Exhibition there. The President of the Committee is M. E. Renou, Vice-President of the French Meteorological Society. A preliminary programme has been issued, setting forth the questions to be discussed under (1) scientific hydrology; (2) medical hydrology; and (3) climatology. The subscription of membership is 12 francs.

The new Marine Biological Laboratory at Wood's Holl, Massachusetts, was formally opened on the day appointed, Tuesday, July 17. Several members of the Board of Trustees, a few students, and a half-dozen or more of guests were present, and spent the morning in examining the new building and its equipment, and in visiting the laboratories and aquaria of the United States Fish Commission. At two o'clock the whole party dined at Gardiner Cottage—the domestic head-quarters of the new enterprise—which a generous citizen of Wood's Holl, Mr. J. S. Fay, has kindly put at the disposal of the trustees. Shortly after three o'clock the Director, Dr. C. O. Whitman, delivered in the Laboratory an opening address upon the history and functions of marine biological laboratories, referring especially to the Penikese School and to Prof. Baird's labours in this direction. Prof. C. S. Minot then said a few words on behalf of the trustees. Some eight or ten students are already at work in the Laboratory; and *Science* says that the responses from colleges and from students make it certain that next year there will be at the institution a large and enthusiastic gathering of investigators and students in biology. The building, according to *Science*, appears to be admirably adapted to its purposes. It is plainly but strongly built, of wood, two stories high, and with a pitched roof. The roof and sides are covered with shingles, unpainted. There is a commodious and convenient basement under the western half of the building, intended for storage, for the safe keeping of alcohol, boats, oars, and the like. The lower floor of the Laboratory is intended for beginners, and for teachers and students who are learners but not investigators. The upper story is for investigators only. The equipment includes work-tables, specially designed, and placed before the large and numerous windows. Each student is provided with a Leitz microscope, a set of reagents, watch-glasses, dissecting pans, and the dishes and other things indispensable to good work. The Laboratory owns boats, dredges, nets, and other tools for collecting. A small library has been provided, and, under the progressive and efficient management of Dr. C. O. Whitman and Mr. B. H. Van Vleck, a season that promises to be highly successful, and most important in the history of American biology, has been auspiciously begun.

Mr. Henry O. Forbes, the New Guinea explorer, author of "The Naturalist in the Malay Archipelago," has been selected by the London Commission to succeed the late Sir Julius von Haast as Director of the Canterbury Museum, New Zealand.

Some time ago a good deal of interest was aroused by a controversy as to the effects of light on water-colours. The Committee of Council appointed a Committee of artists to consider the subject; and Dr. W. J. Russell and Captain Abney were invited to investigate the scientific aspects of the question. A Blue-book has just been issued, containing the first report of these two gentlemen.

We regret to record the death of Miss Glanville, who was well known in South Africa as the Curator of the Albany Museum, Grahamstown, Cape of Good Hope. This clever and accomplished young lady discharged her duties as Curator most conscientiously and ably, and did much to promote an interest in science in her native town and country.

A new gas, possessing some remarkable properties, has been discovered by Prof. Thorpe and Mr. J. W. Rodger, in the research laboratory of the Normal School of Science. It is a sulpho-fluoride of phosphorus of the composition PSF_3, and is termed by its discoverers thiophosphoryl fluoride. The best method for its preparation consists in heating pentasulphide of phosphorus with lead fluoride in a leaden tube. It may also be obtained by substituting bismuth fluoride for the fluoride of lead, the only difference between the two reactions being that the second requires a higher temperature than the first. Again, when sulphur, phosphorus, and lead fluoride are gently warmed together, an extremely violent reaction occurs, but if a large excess of the fluoride of lead be employed a tolerably steady evolution of the new gas occurs, the excess of the lead salt appearing to act as moderator. It is an interesting fact, throwing considerable light upon the constitution of the sulpho-fluoride, that it may be obtained by heating together to 150° C. in a sealed tube a mixture of the corresponding chloride—thiophosphoryl chloride, $PSCl_3$, a mobile colourless liquid—and trifluoride of arsenic. The simple exchange of chlorine for fluorine here brings about a striking physical change, from a highly refracting liquid to a colourless gas. And now for the remarkable properties of the gas. In the first place, it is spontaneously inflammable. If it be collected over mercury, upon which it exerts no action, in a tube terminating above in a jet and stopcock, and the latter be slowly turned so as to permit of its gradual escape, the gas immediately ignites as it comes in contact with the air, burning with a greenish-yellow flame tipped at the apex with blue. If, however, a wide tube containing the gas standing over mercury be suddenly withdrawn from the mercury trough, the larger mass of gas ignites with production of a fine blue flash, the yellowish-green tint again being observed as the light dies away. Thiophosphoryl fluoride is readily decomposed by the electric spark with deposition of sulphur. If a quantity contained in a tube over mercury be heated for a considerable time, complete decomposition occurs, sulphur and phosphorus both being deposited upon the sides of the tube and gaseous silicon tetrafluoride left. From a spectroscopic examination, dissociation was shown to occur at the lowest temperature of the electric spark. The gas is slowly dissolved by water, and appears to be somewhat soluble in ether, but alcohol and benzene exert no solvent action upon it. Finally, the colourless, transparent gas was reduced to a liquid, somewhat resembling the sulpho-chloride, by means of Cailletet's liquefaction apparatus.

A volcanic eruption, which began on August 3, in the Island of Vulcano, one of the Lipari Group, is said to have done an immense amount of injury. The greatest damage has been caused on the property of an English company under the management of Mr. Harleau, the estate being completely destroyed.

We have received the Year-book of the Meteorological Observations of the Observatory of the *Madgeburg Journal* for the year 1886, being the fifth of the series. It contains observations taken three times daily, with means and monthly summaries according to the international scheme, hourly observations of the self-recording instruments, and fac-similes of the sunshine records; also additional observations, such as earth-temperature, evaporation, underground water, &c., as in previous years. The principal alteration is the omission of the continuous barograms: these are now given only in cases of special interest, owing to the expense of the reproduction. We have already expressed our approval of this method of dealing with continuous records, as opposed to the costly reproduction of the curves in their entirety.

The "Annuaire" of the Municipal Observatory of Montsouris for the year 1888, just published, a volume of 612 pages, 18mo, contains a large amount of useful information, relating to the meteorology of Paris, and the microscopical examination of the organisms in the air and water. The report shows that the site of the Observatory is favourable for determining the climate of Paris with exactitude; some of the thermometric differences between Paris and Montsouris are very marked. The amount of rainfall also is somewhat greater at Montsouris, owing probably to better exposure than at Paris, but the differences are not greater than are frequently found with gauges placed near each other. The tables contain monthly means of temperature from the year 1806, and of rainfall since 1689; the values prior to 1873 are those referring to Paris. Self-registering thermometers were first used in 1835; up to this date the minimum temperatures were taken as the readings at sunrise, and the maximum readings, as those at 3 p.m. The yearly extremes of temperature date back to 1699.

We learn from *Science* that the famous Bahia or Bendego meteorite, described by Mornay and Wollaston in the Philosophical Transactions for 1816, and by Spix and Martius in their "Travels in Brazil," was landed in Rio de Janeiro on June 15, and is now in the collection of the Brazilian National Museum. The transportation of this great mass of iron, whose weight was variously estimated from six to nine tons, and which has been found to weigh 5361 kilogrammes, was rendered possible by the recent completion of a line of railroad passing within 115 kilometres of the Bendego Creek, where it has lain since the unsuccessful attempt to remove it to Bahia in 1785. Credit for the removal of the meteorite is due chiefly to Chevalier José Carlos de Carvalho, who gratuitously took charge of the technical part of the operation, and to Baron Guahy, who paid all the necessary expenses. The Brazilian Government also cordially associated itself with the undertaking. After about three months spent in preparing material and in studying the route to be traversed, the march began on November 25, 1887, and the meteorite was placed on the railroad on May 14 of the present year. A road had to be opened for this special purpose, as those existing in the region are only mule paths; and over one hundred streams, one with a width of 80 metres, had to be crossed by temporary bridges. The route lay over several chains of hills and one mountain range, in which an ascent of 265 metres had to be overcome with a grade of 32 per cent.

The Canadian Institute, Toronto, has issued a "sociological circular," asking co-operation in the task of collecting trustworthy data concerning the political and social institutions, customs, ceremonies, &c., of the Indian people of the Dominion. Suitable papers upon the topics indicated will be published in the Institute's Proceedings. The Canadian Pacific Railway carries, free of charge, packages intended for the Institute's Museum, which is open daily.

The Kew Bulletin for the months of November 1887 and January 1888 supplied valuable information, derived from official sources, respecting the capabilities of certain colonies for the production of fruits. The Bulletin for November 1887 was wholly devoted to a comprehensive report on the fruits of Canada. The Bulletin for January 1888 was devoted to reports furnished by their respective Governments on the fruits of Victoria, South Australia, Western Australia, Tasmania, New Zealand, Cape Colony, and Mauritius. In the Bulletin for August, just issued, the publication of such reports is continued. A summary of information is presented relating to the fruit productions and fruit resources of the West Indian colonies—Jamaica, Bahamas Islands, Barbados, St. Lucia, St. Vincent, Grenada, Tobago, Trinidad, and British Guiana.

The Report of the Comptroller-General of Patents, Designs, and Trade Marks for the past year states that the total number of patents applied for was 18,051, being an increase of about 900 on the year before; of designs, 26,000 as against 24,000 of the preceding year; and of trade marks, 10,586, being a decrease of 91 from the preceding year.

The American Statistical Association publishes some interesting figures on the amount of water-power employed in the United States. In 1880 there was a total water-power equal to 1,225,379 horse-power used for manufacturing-purposes, this being 35·9 per cent. of the total power thus employed in the States. The annual value of the water-power thus utilized is set down at 24,000,000 dollars. The New England States alone use 34·5 per cent. of the whole water-power of the country, and altogether the Atlantic States use over three-fourths of the whole.

According to a return of the Board of Trade on sea-fisheries in the United Kingdom, the total amount of fish landed on the English and Welsh coasts, exclusive of shell-fish, was, in 1887, about 301,000 tons, of the value of about £3,780,000. Shell-fish taken in that year were of the value of £324,000. For the year 1886 the figures were—fish landed, 320,000 tons, of the value of £3,688,000, and shell-fish of the value of £269,000. Thus, while there was a decrease in weight of about 19,000 tons, there was an increase in value of about £90,000, and in the shell-fish an increase of £55,000.

In a Report of M. Renduel to the French Minister of Marine, he attributes the gradual decline of the sprat-fisheries of France to the methods hitherto pursued in fishing. The sprat seine-net, he says, is most destructive. When thrown out fully, as is usually the case, and then towed towards the shore, it drags the bottom over an enormous area, and brings to land not only the sprats, but shoals of other fish not yet fully developed, and quite unsalable. The French newspapers say, with a little pardonable exaggeration perhaps, that thousands of cubic metres of winter fry, which would give in summer millions of cubic metres of edible fish, have been used as manure in the fields, in order to force grass and cereals. So far has this been carried, that the non-migratory fish are almost exterminated in many places.

In the Report of the British Consul at Tunis to the Foreign Office, he says that the sponge fishery is a very important branch of industry in that country. There are in all about 400 Greeks, 500 Sicilians, and 1400 natives engaged in the pursuit. The diving apparatus was formerly in use, but it has given way to a kind of dredging instrument similar to that used in the oyster fishery. The same Report says that the tunny fishery is a monopoly of the State. The fish enter the Mediterranean in the spring, and one body of them strikes the coast at Cape Bon. Here the net-fishing begins. The boats gather around the nets, and the fish are harpooned and dragged into the boats, as many as 600 being thus frequently taken in one haul. They are then cut up and preserved in olive-oil, packed in tins of various sizes, and soldered up. About three-fourths of the fish are thus treated, and sent away to Italy, where they meet a ready sale. The rest are either eaten fresh, or salted and sent away to Malta or Sicily. Between 200 and 300 men are engaged in this work, which is of the annual value of £20,000.

A very rare fish, *Plagyodus* (*Alepisaurus*) *ferox*, has just been caught in the Karlsöfjord, in Iceland. It is 5 feet 9 inches long, with small shark-like fins, those on the back being about a foot in length. The head is pointed, and the teeth long and sharp. It appeared to lie asleep on the surface of the water, and a fisherman caught it by its tail, when it attempted to bite him. Prof. Lütken states that hitherto only three specimens of this fish have been caught, viz. one at Madeira, one in Greenland, and one previously in Iceland. It is believed that this is the mysterious fish the *fax-ál*, *i.e.* the eel with a mane, of which the Faroe fishermen stand in such awe.

THE Assistant Superintendent of the Forest Department of Penang has tried the raising of mahogany-trees from seeds, but with what success is not yet known. He also tells us that a trial venture in cultivating patchouli has proved very successful. Experiments in growing olives, oranges, citrons, &c., have proved encouraging, and trials with European vegetables show that tomatoes, carrots, lettuce, onions, celery, &c., can be successfully cultivated in the Straits Settlements.

IN "The Fodder Grasses of Northern India," just published at Roorkee, Mr. J. F. Duthie gives an instructive account of the more important kinds of grasses that are used in the plains of Northern India either for fodder or for forage. Several of the plains species extend up to considerable elevations on the Himalaya, but Mr. Duthie has omitted all mention of those which are exclusively Himalayan. The area of country to which the work refers, and which coincides with that over which his botanical researches generally will in future be conducted, extends from the north-west frontier, and includes the Punjab, the North-West Provinces, and Oudh, Sindh, Rájputána, Central India, and the Central Provinces.

A NEW edition of the Catalogue of Lewis's Medical and Scientific Library has just been issued. It includes a classified list of subjects, with the names of those authors who have dealt with them.

THE first University of Siberia has just been opened at Tomsk. It has for the present only one Faculty, that of Medicine. How urgently necessary the establishment of this Siberian Faculty of Medicine has become may be seen from some figures sent to the *Times* the other day by its St. Petersburg Correspondent. The practice of one doctor is supposed to extend over each of the following districts, with their respective populations :—Tobolsk, 129,785 square versts, 110,323 inhabitants ; Akmolinsk, 87,833 square versts, 80,062 inhabitants ; Semipalatinsk, 85,705 square versts, 100,225 inhabitants. In short, there are only twenty-two doctors over an enormous territory of 2,815,547 square versts.

IN the article "Lord Armstrong on Technical Education," in our last issue, an unfortunate slip occurs at p. 314, in the second column, which destroys the force of the argument : £74,000, not £24,000, should have been stated as the sum which it was proposed to spend on the erection of a new chemical department of the Zurich Polytechnicum.

THE additions to the Zoological Society's Gardens during the past week include a Purple-faced Monkey (*Semnopithecus leucoprymnus* ♂) from Ceylon, presented by Mr. Martin J. Cole ; a Rhesus Monkey (*Macacus rhesus* ♂) from India, presented by Mr. Reginald S. Knott ; three Black-eared Marmosets (*Hapale penicillata*) from South-East Brazil, presented by by Mr. J. A. Deintje ; a Chipping Squirrel (*Tamias striatus*) from North America, presented by Mrs. Matveiff; a Common Squirrel (*Sciurus vulgaris*) British, presented by Mr. R. Grant Watson ; a Tayra (*Galictis barbara* ♂) from South America, presented by Mrs. J. H. Pollard ; a Lesser Sulphur-crested Cockatoo (*Cacatua sulphurea*) from Moluccas, presented by Mr. J. Wolfe Barry ; a White-backed Piping Crow (*Gymnorhina leuconota*) from Australia, presented by Miss Alice Rutherford ; a Herring Gull (*Larus argentatus*), British, presented by Mrs. Huthwaite ; an Ashy-headed Gull (*Larus cirrhocephalus*), a —— Bittern (*Butorides* ——) from South America, presented by Dr. A. Boon, C.M.Z.S. ; a Common Kestrel (*Tinnunculus alaudarius*), British, presented by Mr. W. A. W. Jones ; a Smooth Snake (*Coronella lævis*) from Hampshire, presented by Mr. E. G. Meade-Waldo ; a Rhesus Monkey (*Macacus rhesus* ♂) from India, a Common Boa (*Boa constrictor*) from South America, an Æsculapian Snake (*Coluber æsculapii*) from Langenschwalbach, Germany, deposited.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET.—Encke's comet was picked up at the Cape Observatory on August 3, its place at 6h. 10m. 56·6s. being recorded as R.A. 12h. 12m. 59s. ; Decl. 17° 27′ 46″ S. This compares with Dr. Backlund's ephemeris (*Astr. Nach.*, No. 2843) as follows : O − C ; R.A. + 4m. 43s. ; S. Decl. + 34′ 52″. The ephemeris for the next few days runs as below :—

For Berlin Midnight.

1888.	R.A. h. m. s.	Decl. ° ′	Log *r*.	Log Δ.	Brightness.
Aug. 10	13 9 20	23 30·2 S.	0·0038	9·8790	0·69
12	13 25 34	24 56·1	0·0176	9·8896	0·62
14	13 41 21	26 11·4	0·0308	9·9014	0·55
16	13 56 36	27 17·2	0·0435	9·9142	0·49
18	14 11 21	28 13·7	0·0556	9·9275	0·44
20	14 25 28	29 1·7	0·0673	9·9415	0·39
22	14 38 59	29 41·9	0·0785	9·9559	0·35
24	14 51 52	30 15·4	0·0893	9·9708	0·31
26	15 4 10	30 42·7	0·0997	9·9857	0·27
28	15 15 54	31 5·3 S.	0·1097	0·0009	0·24

The brightness at discovery is taken as unity.

THE MASS OF TITAN.—The values which have been deduced for the mass of Titan by different astronomers showing a wide diversity, Mr. G. W. Hill has undertaken, in *Gould's Astronomical Journal*, No. 176, a new determination of this constant from the influence of Titan on the motion of Hyperion. Assuming Hyperion to be in opposition to Titan, at the same time that it is in perisaturnium, then, at the end of the half-synodic period—viz. 31·8182806d.—it would be in conjunction with Titan ; and but for the action of Titan, ϕ, the angle the radius-vector makes with the direction of motion, would $= 90° 8' 51''·85$. But the influence of Titan reduces this to a right angle, and this effect may be used to discover the mass of that body. Computing the motion of the line of apsides during the half-synodic period from opposition to conjunction, all powers but the first of the disturbing force being neglected, the value of Δw corresponding to the argument 31·81828d. was found to be $-2634''$ instead of $-5898''$, as given by observation. The mass, therefore, of Titan would require to be changed from 1/10,000, the value assumed at first, to 1/4466. The eccentricity of the orbit of Titan, 0·028, had been neglected, and that of Hyperion taken as 0·1. With this better value for Titan's mass, the path of Hyperion from opposition to conjunction is then traced by mechanical quadratures, no powers of the disturbing forces being neglected. The two unknowns to be determined were—the velocity with which Hyperion should start from opposition, and the mass of Titan ; and the two determining conditions—that the conjunction should take place 31·81828d. after opposition, and that Hyperion must be then moving at right angles to its radius-vector. The resulting mass is found to be 1/4714, and the osculating elements of Hyperion at opposition—

$$\text{Daily } n = 60963''·23942$$
$$\log a = 0·0823532$$
$$e = 0·0994706$$

Prof. Newcomb, in one of the "Papers for the Use of the American Ephemeris," vol. iii., part 3, has also described the perturbations of Hyperion arising from the action of Titan, and deduced the mass of Titan as 1/12,500, but Mr. Hill points out hat this value should have been divided by 3. M. Tisserand's value from a similar inquiry, 1/10,750 (*Comptes rendus*, tome ciii. No. 9), stands out in strong contrast with Prof. Hill's result; but Prof. Ormond Stone, on the other hand, who had obtained a larger result, has more lately, after correction of an error in his investigation, brought it down to a value closely according with that of Prof. Hill.